Stepper Motors in C

ECE 376 Embedded Systems

Jake Glower - Lecture #11

Please visit Bison Academy for corresponding
lecture notes, homework sets, and solutions

Stepper Motors in C

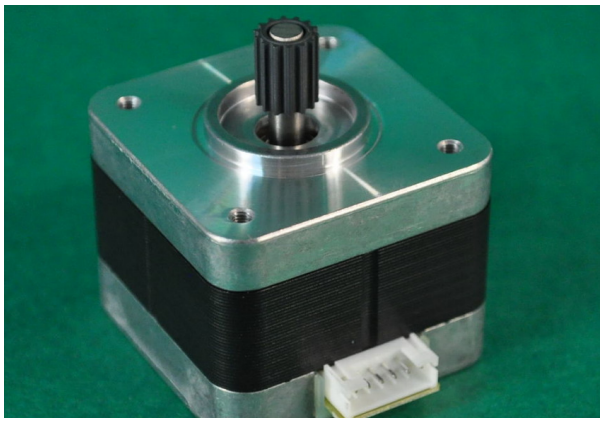
- 2-phase AC synchronous motor
- Also works as a digital motor

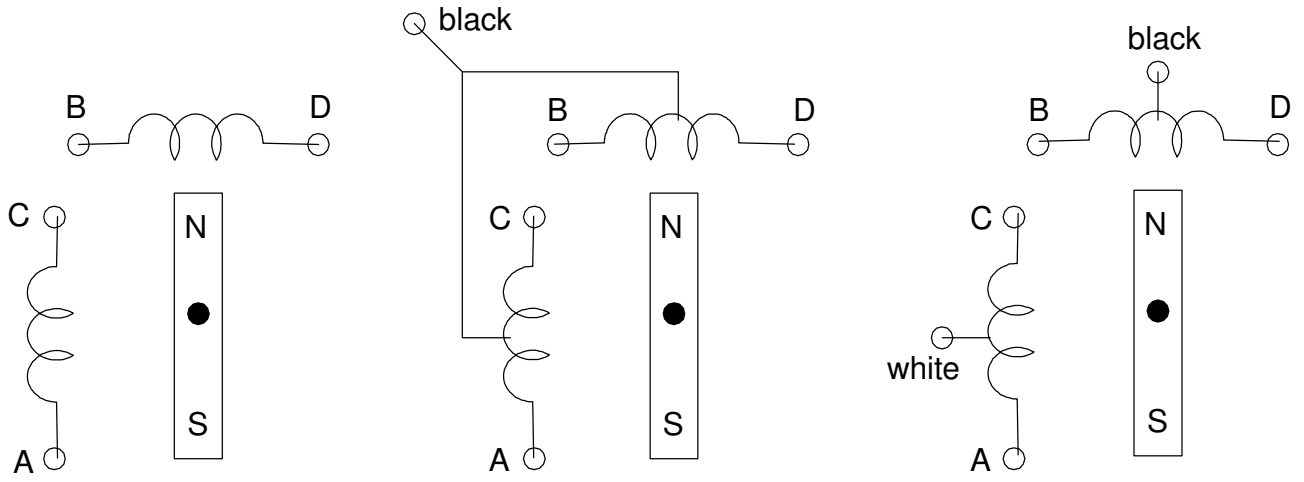
Bipolar: 4 leads

- Needs an H-bridge

Unipolar: 6 leads

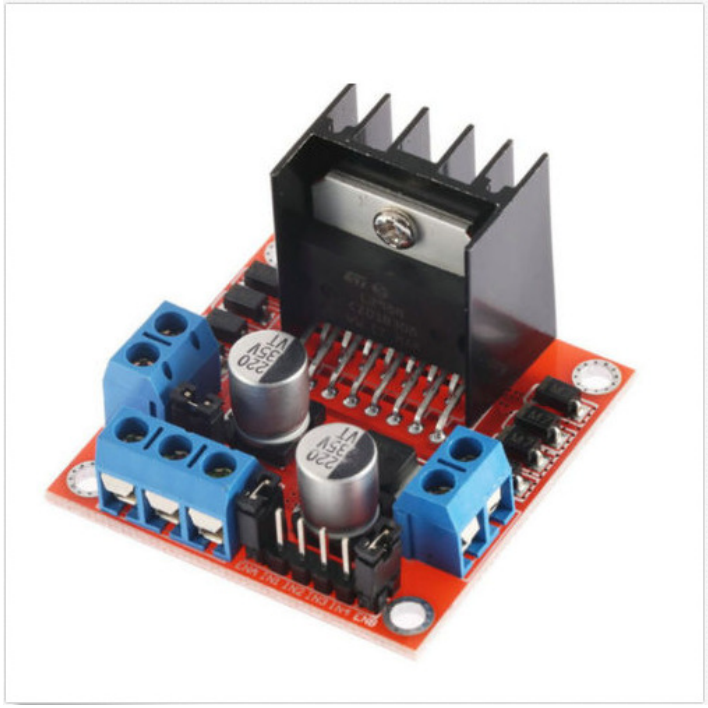
- Can drive with 4 transistors





Hardware Interfacing

- Stepper motor in kit is rated at 10VDC
- Will operate at 5VDC (with lower torque)
- Each phase is 30 Ohms (draws 167mA @ 5V)
- Needs an H-bridge as a buffer



Stepper Motor Drive Controller Board Module L298N Dual H Bridge

Top selling product ★★★★★ 1 product rating

Item condition: **New**

Quantity: 1 More than 10 available
121 sold / See feedback

Price: **US $1.99**

Buy It Now

Add to cart

13 watching

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121 sold	Experienced seller	30-day returns

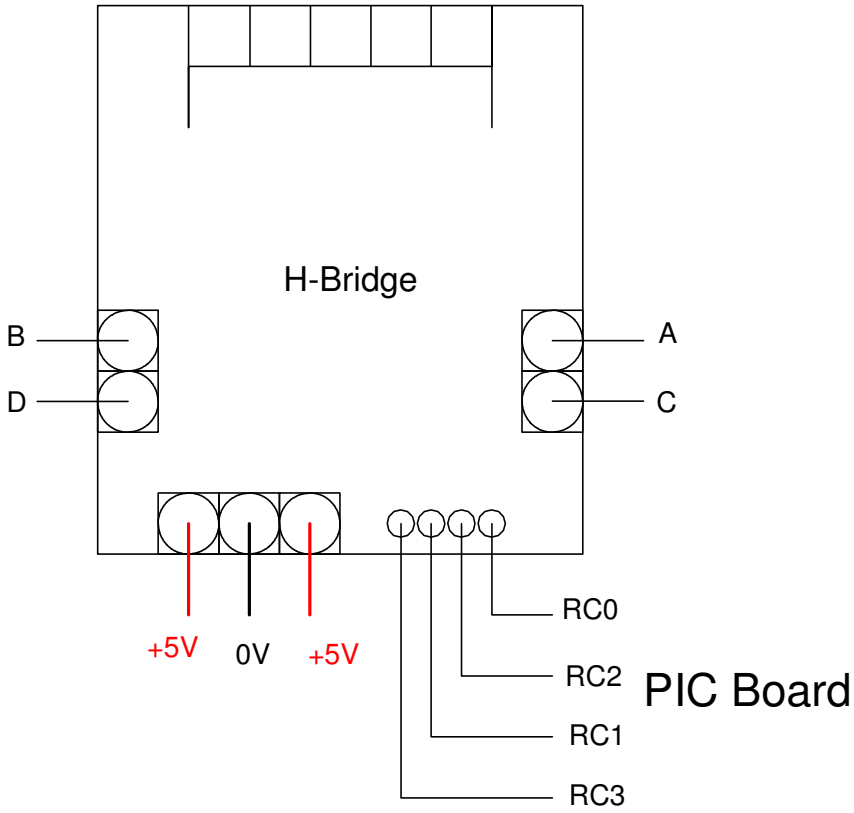
Shipping: **$3.00** Standard Shipping | See details
Item location: Bensenville, Illinois, United States
Ships to: United States See exclusions

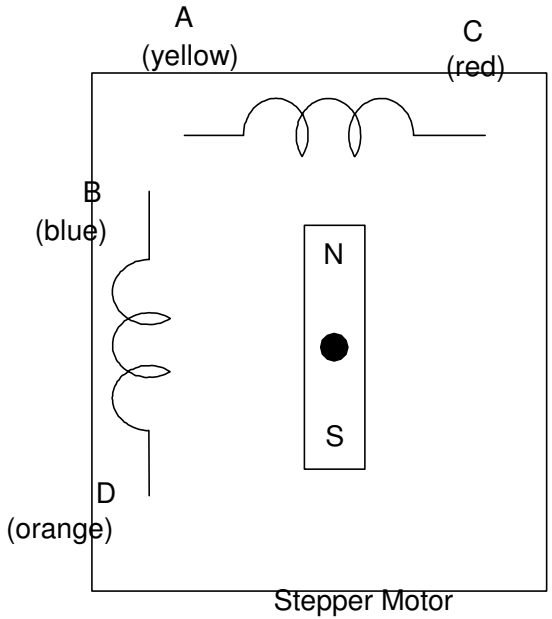
Delivery: Estimated on or before **Mon. Aug. 28** to 58104

Payments: PayPal VISA

Credit Cards processed by PayPal

H-Bridge: Wiring





Wiring for the H-Bridge. Note that PORTC pins alternate on the input

Software

Full Stepping
200 steps / rotation

```
PORTC

0 0 0 1
0 0 1 0
0 1 0 0
1 0 0 0
```

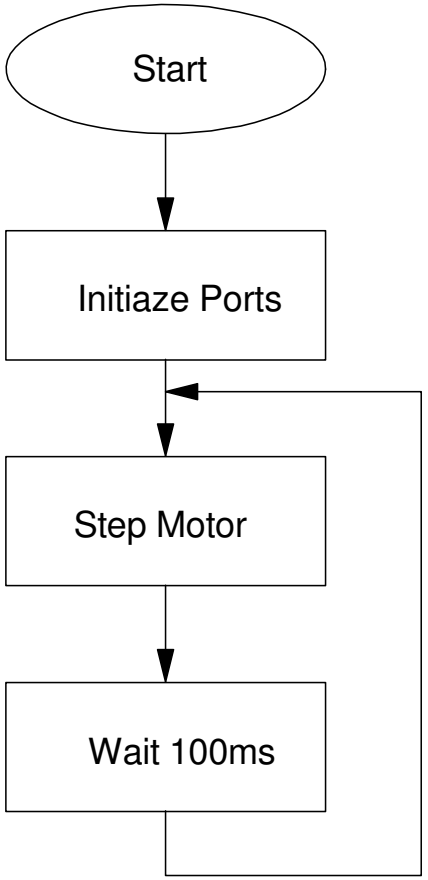
Half Stepping
400 steps / rotation

```
PORTC

0 0 0 1
0 0 1 1
0 0 1 0
0 1 1 0
0 1 0 0
1 1 0 0
1 0 0 0
1 0 0 1
repeat
```

Case 1: Full-Stepping Every 100ms (Stepper1.C)

- Use a look-up table
- Spin through the table, one step every 100ms

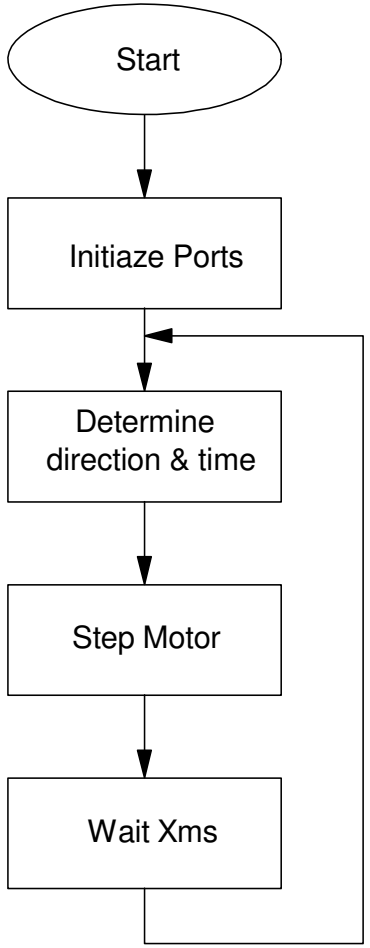
```
// Global Variables
unsigned char TABLE[4] = {1, 2, 4, 8};


   while(1) {
      STEP = STEP + 1;
      PORTC = TABLE[STEP % 4];
      LCD_Move(1,0);
      LCD_Out(STEP, 5, 0);
      Wait_ms(100);
      }
```



Case 2: Speed Control (Stepper2.c)

- RB4: Forward, 30ms / step
- RB3: Forward, 100ms / step
- RB2: Stop
- RB1: Reverse, 100ms / step
- RB0: Reverse, 30ms / step

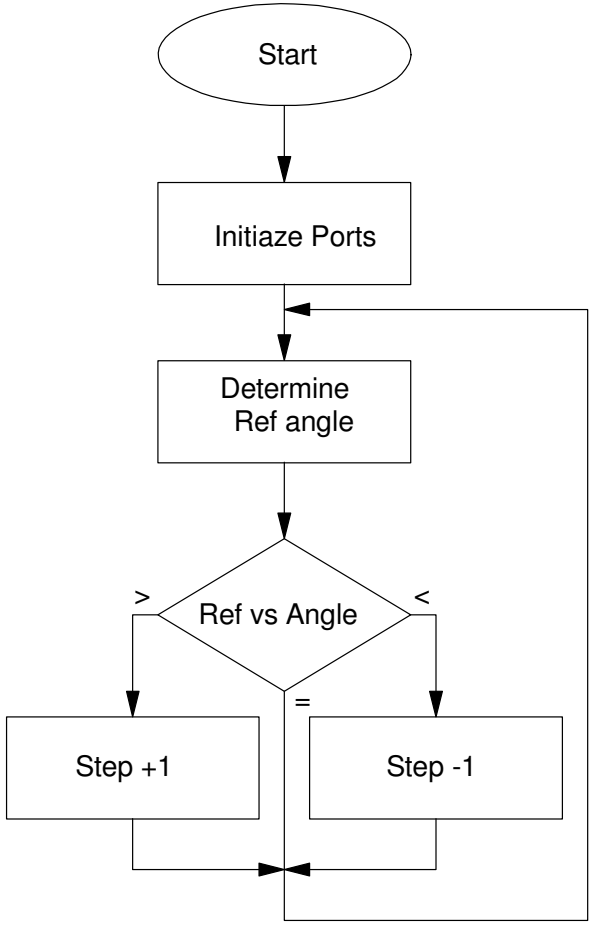
```
while(1) {
   if(RB0) { DIR = -1;  MS = 100; }
   if(RB1) { DIR = -1;  MS =  30; }
   if(RB2) { DIR =  0;  MS =  30; }
   if(RB3) { DIR =  1;  MS =  30; }
   if(RB4) { DIR =  1;  MS = 100; }

   STEP = STEP + DIR;
   PORTC = TABLE[STEP % 4];
   LCD_Move(1,0);
   LCD_Out(STEP, 5, 0);
   Wait_ms(MS);
   }
```



Case 3: Position Control

- RB4: 100 steps (360 degrees)
- RB3: 75 steps (270 degrees)
- RB2: 50 steps (180 degrees)
- RB1: 25 steps (90 degrees)
- RB0: 0 steps (0 degrees)

```
while(1) {
    if(RB0) REF = 0;
    if(RB0) REF = 25;
    if(RB0) REF = 50;
    if(RB0) REF = 75;
    if(RB0) REF = 100;

    if (STEP < REF) STEP = STEP + 1;
    if (STEP > REF) STEP = STEP - 1;

    PORTC = TABLE[STEP % 4];
    LCD_Move(1,0);
    LCD_Out(STEP, 5, 0);
    Wait_ms(30);
    }
```



Linear Actuators:

- Stepper Motor
- The shaft is fixed and the motor spins

Rotor = 3/8 x 16 screw

- 16 rotations moves the shaft 1 inch
- 3200 steps moves the shaft 1 inch

Specs:

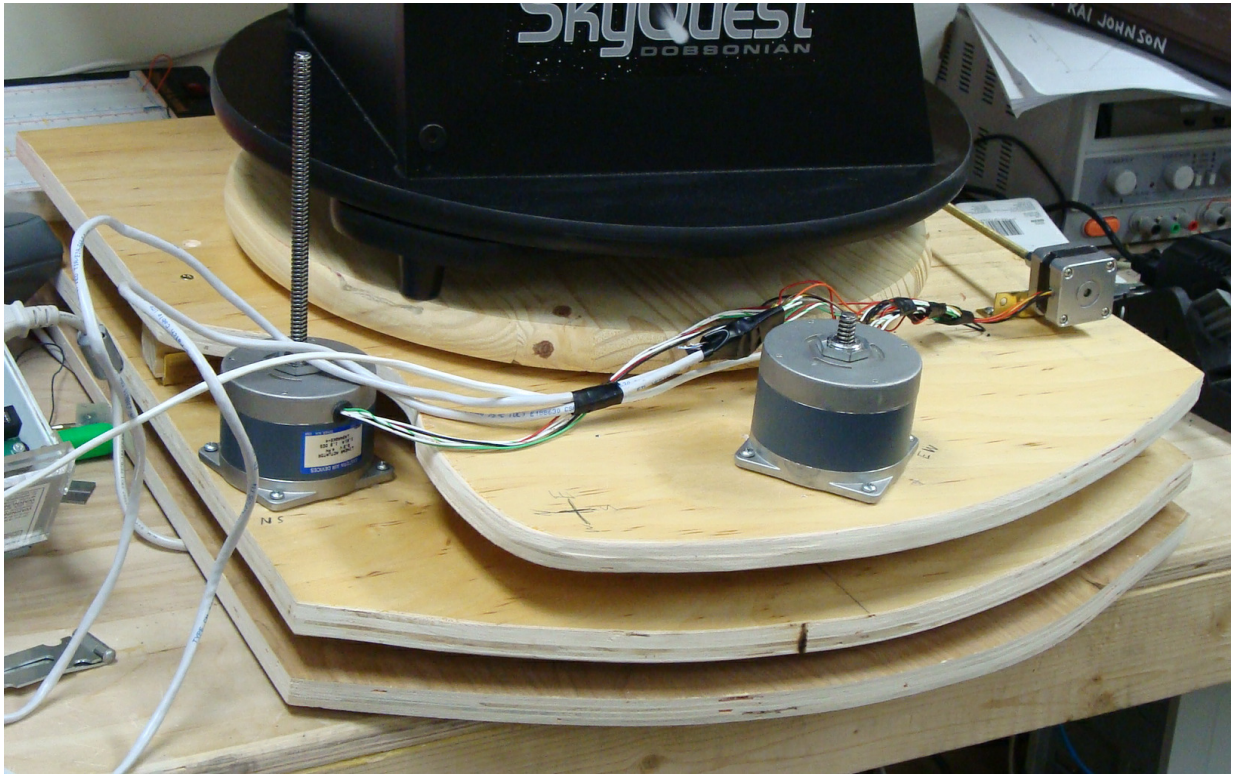
- 17V, 0.46A
- 200 steps per rotation
- 3200 steps per inch
- 50 pounds force
- $350 new
- $17 on ebay (search Eastern Air Devices Linear Actuator)

Linear Actuator Application

- Precise control of position
- Large force

Trebouchet Aiming

Equatorial Platform

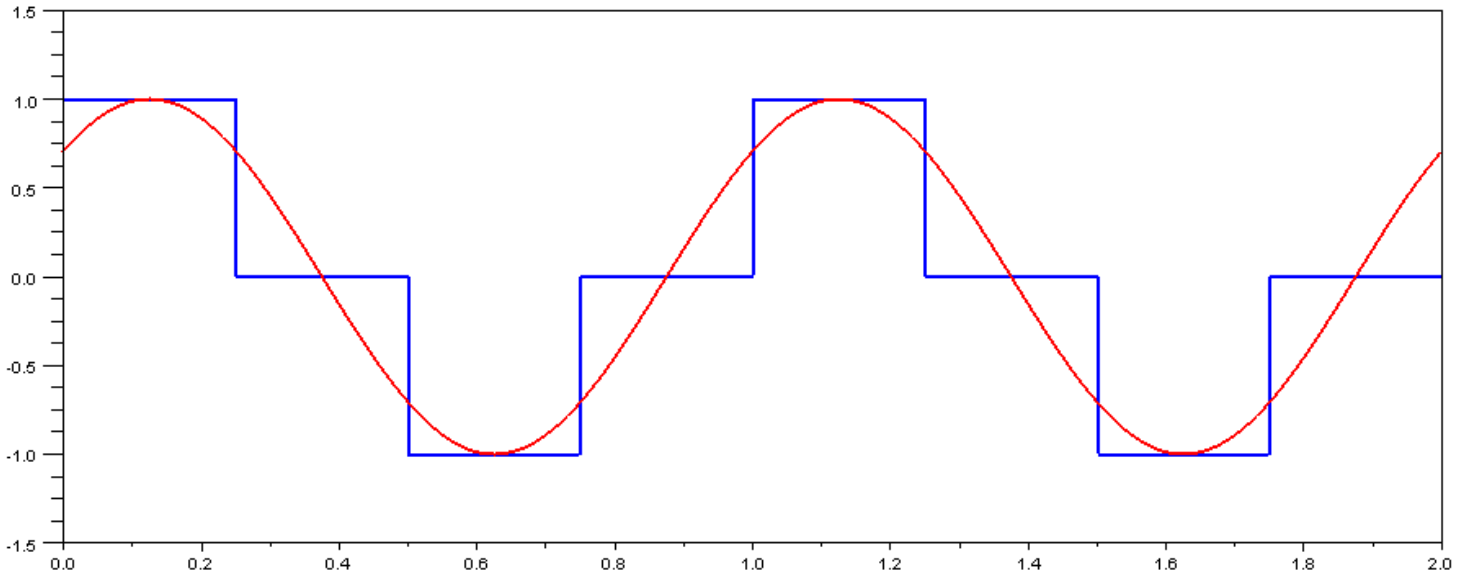


Microstepping:

A stepper motor is actually an AC synchronous machine:

- A square wave approximates sine / cosine

If you apply a sine wave, you get smooth (continuous) motion



Signal sent to V_{AC} when using full steps (blue line) or microstepping (red line).